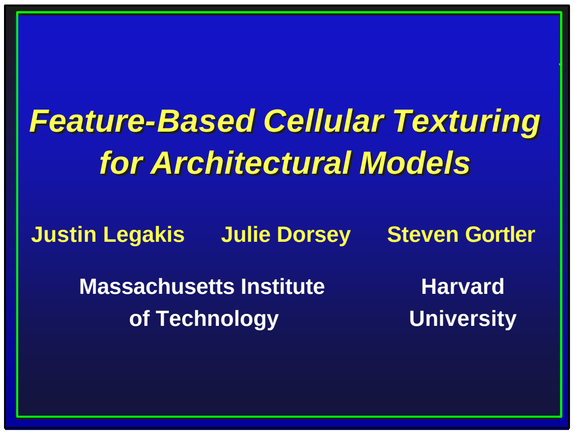
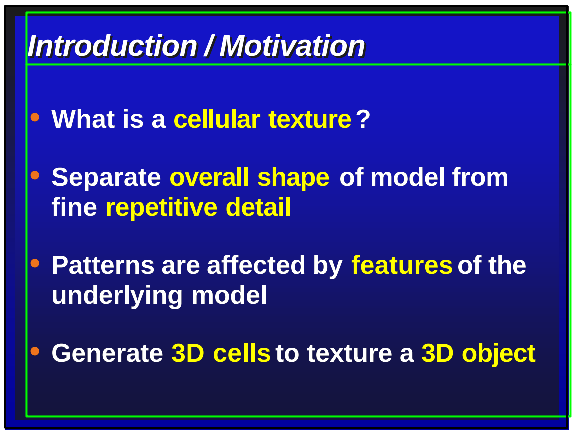


Feature-Based Cellular Texturing for Architectural Models

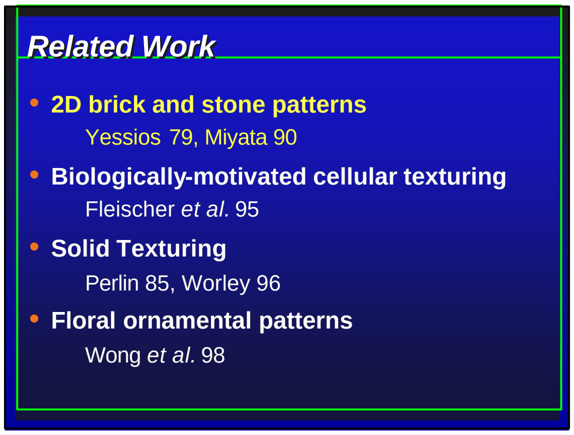
Justin Legakis   Julie Dorsey   Steven Gortler

Massachusetts Institute of Technology   Harvard University



Introduction / Motivation

- What is a cellular texture?
- Separate overall shape of model from fine repetitive detail
- Patterns are affected by features of the underlying model
- Generate 3D cells to texture a 3D object



Related Work

- 2D brick and stone patterns
  Yessios 79, Miyata 90
- Biologically-motivated cellular texturing
  Fleischer *et al.* 95
- Solid Texturing
  Perlin 85, Worley 96
- Floral ornamental patterns
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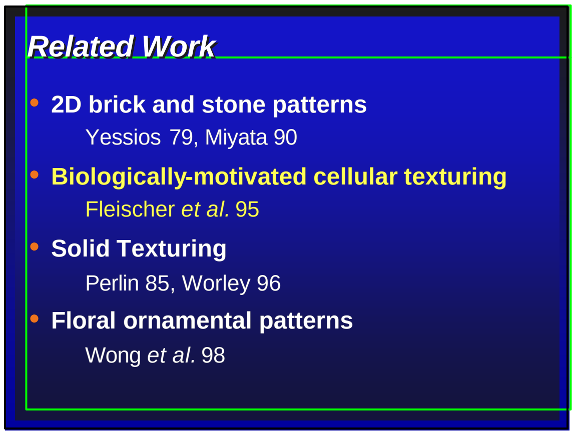

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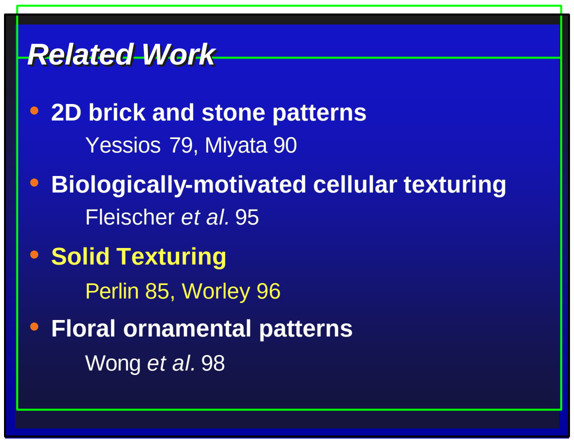

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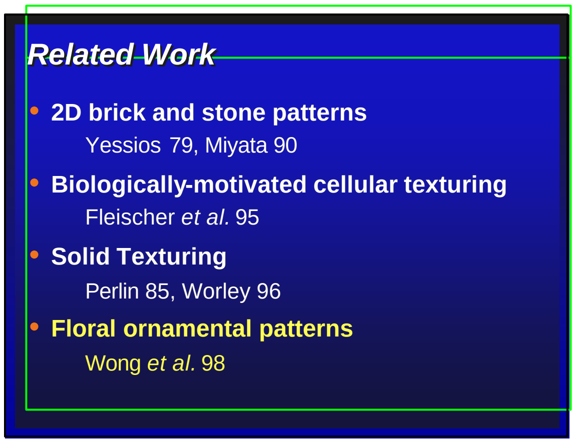

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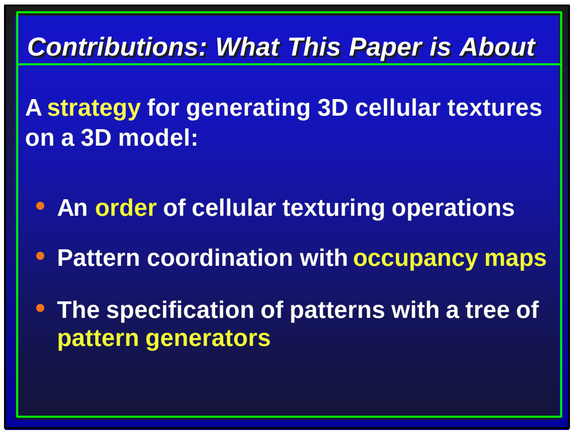
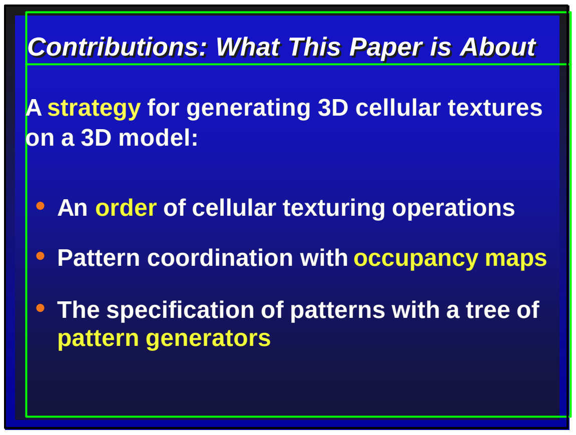


Contributions: What This Paper is About

A strategy for generating 3D cellular textures on a 3D model:

- An order of cellular texturing operations
- Pattern coordination with occupancy maps
- The specification of patterns with a tree of pattern generators



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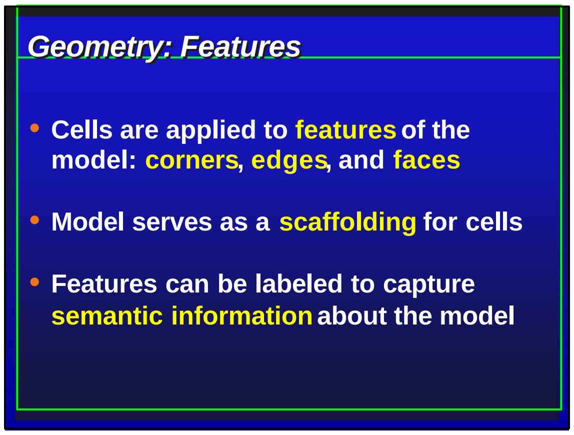
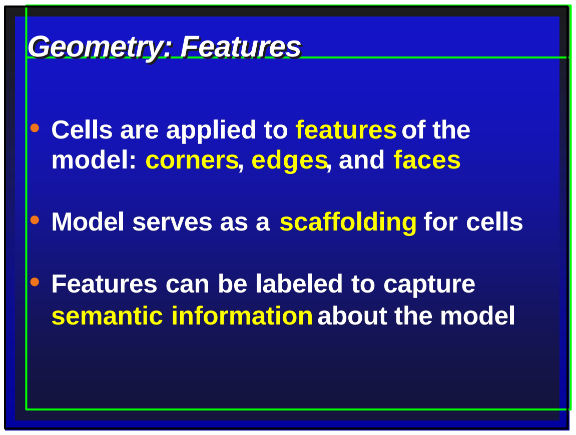


Geometry: Features

- Cells are applied to features of the model: corners, edges, and faces
- Model serves as a scaffolding for cells
- Features can be labeled to capture semantic information about the model



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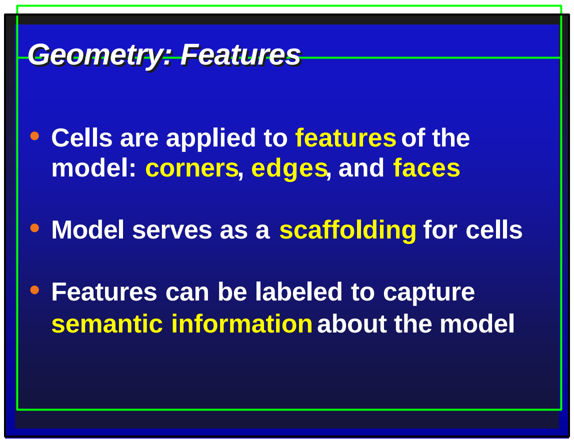

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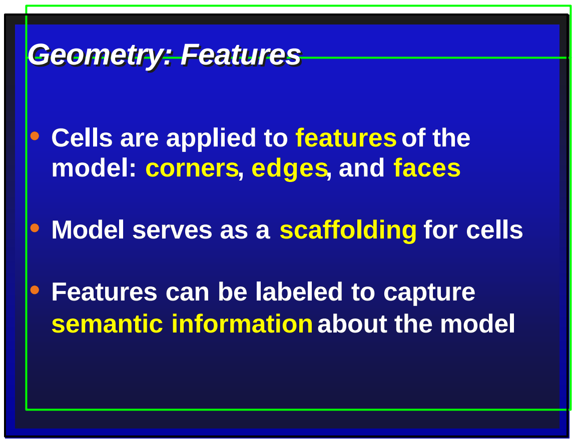

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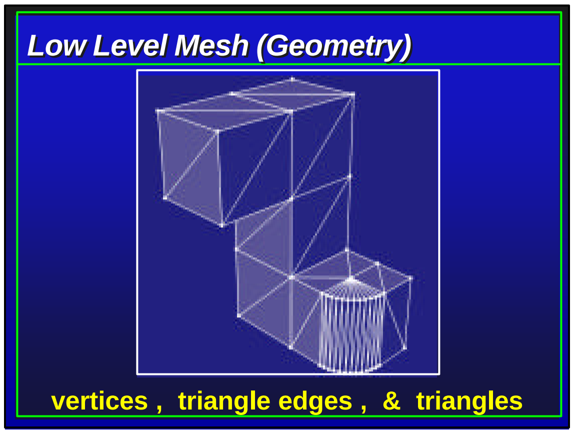
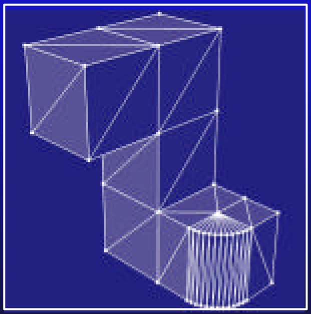
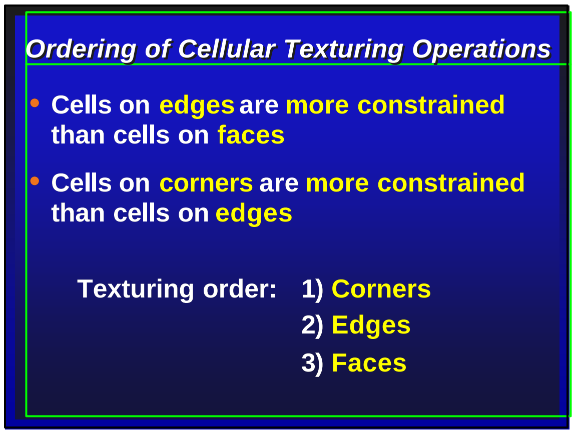


Low Level Mesh (Geometry)



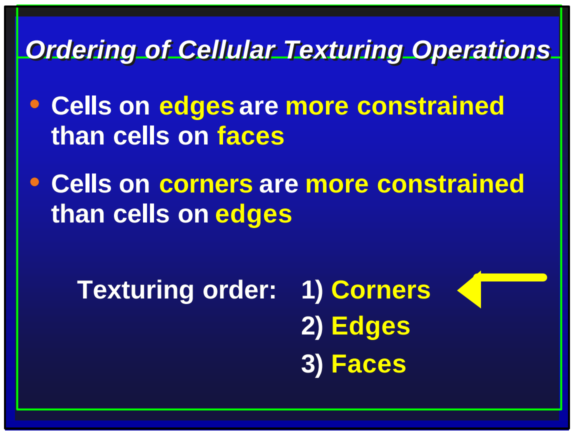
vertices , triangle edges , & triangles



Ordering of Cellular Texturing Operations

- Cells on edges are more constrained than cells on faces
- Cells on corners are more constrained than cells on edges

Texturing order: 1) Corners
2) Edges
3) Faces



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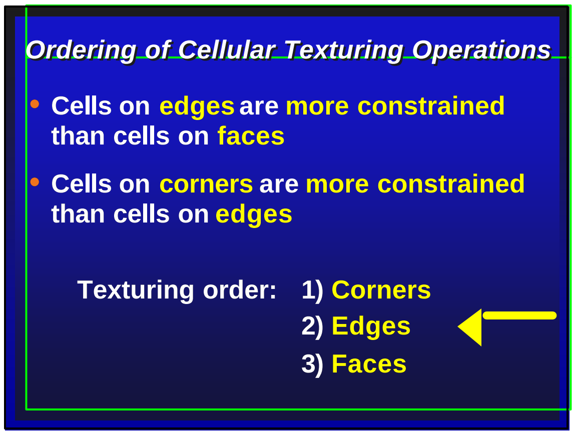

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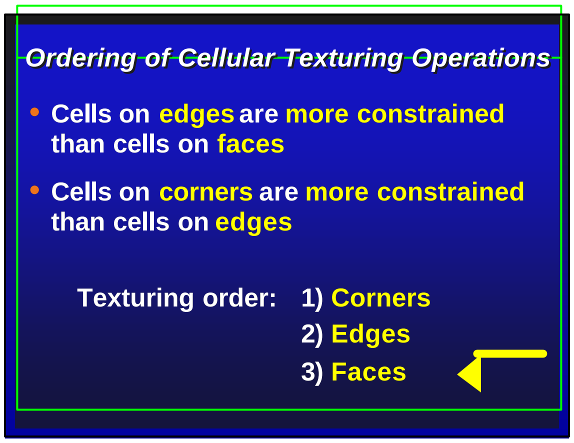

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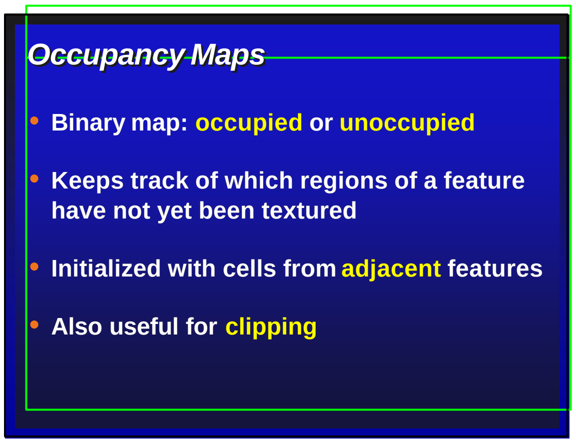
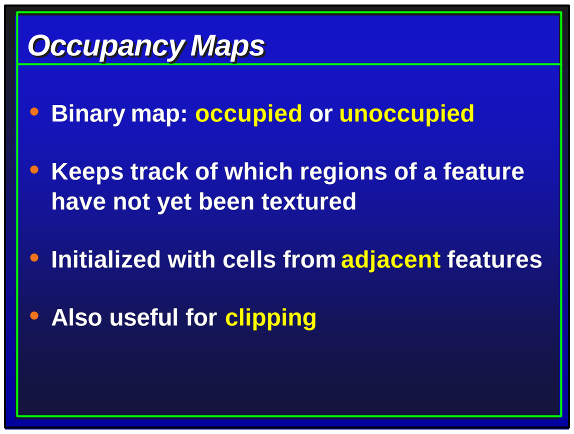


Occupancy Maps

- Binary map: occupied or unoccupied
- Keeps track of which regions of a feature have not yet been textured
- Initialized with cells from adjacent features
- Also useful for clipping



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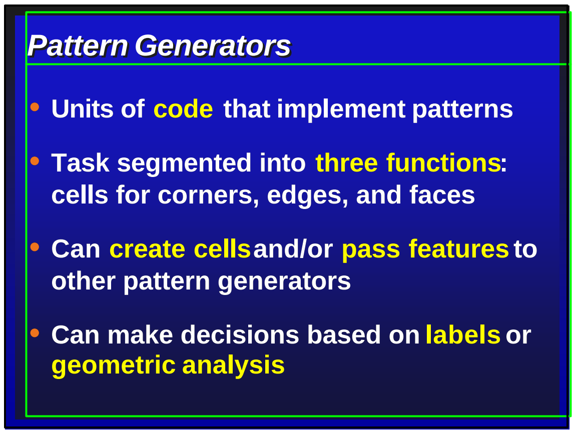
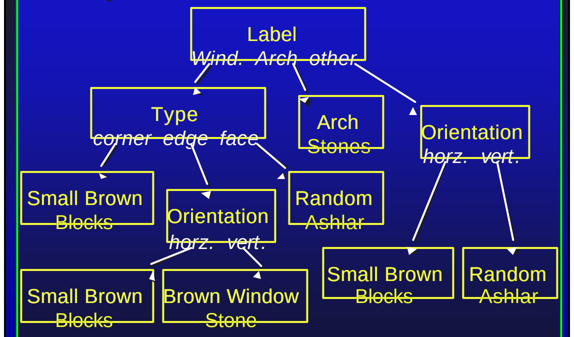


Pattern Generators

- Units of code that implement patterns
- Task segmented into three functions: cells for corners, edges, and faces
- Can create cells and/or pass features to other pattern generators
- Can make decisions based on labels or geometric analysis

Example Pattern Generator Tree



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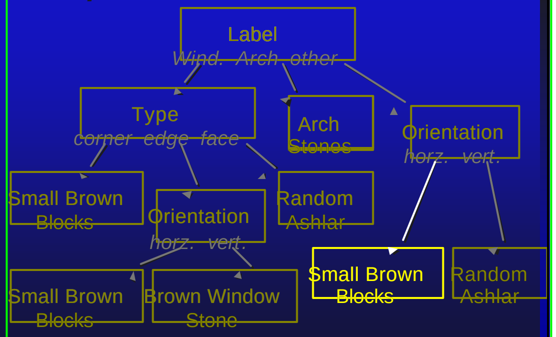

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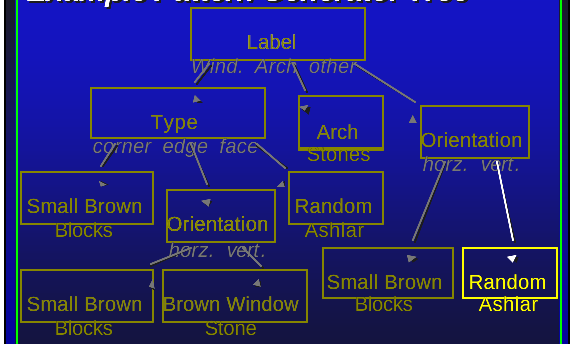

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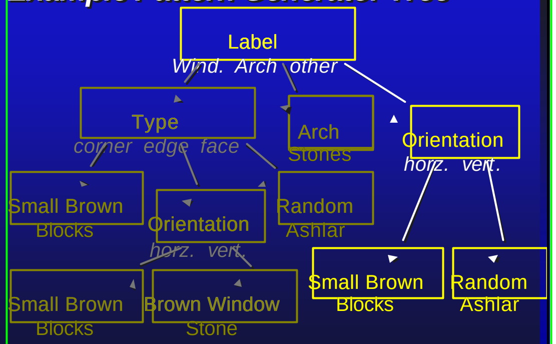

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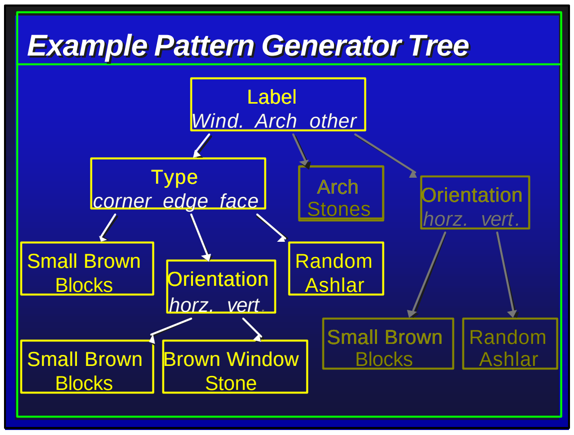

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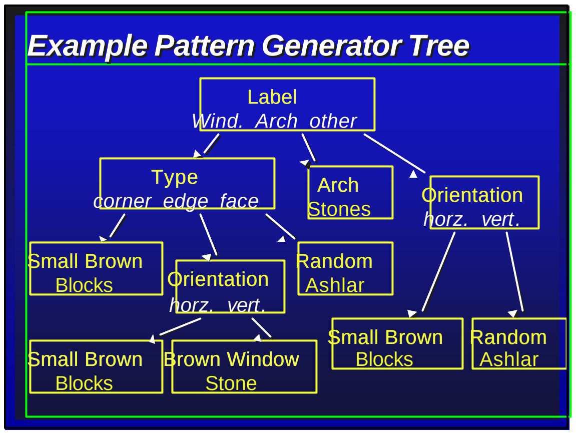
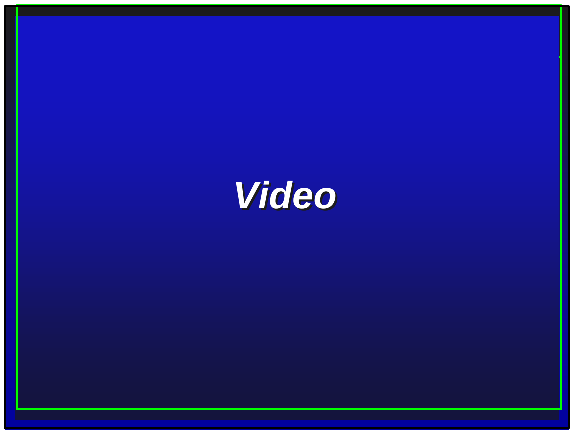
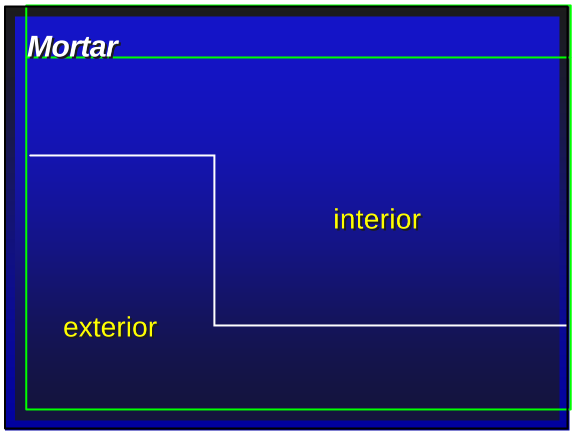




Video

Mortar



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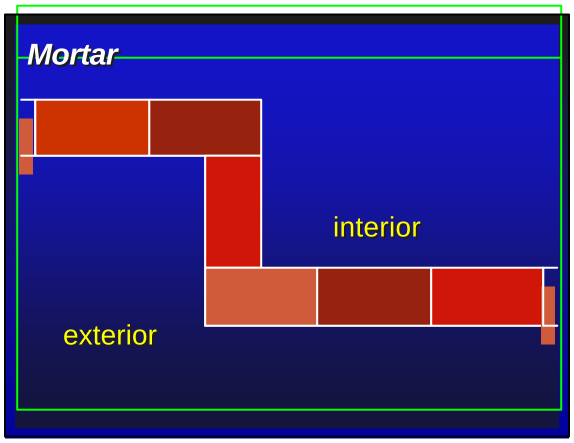

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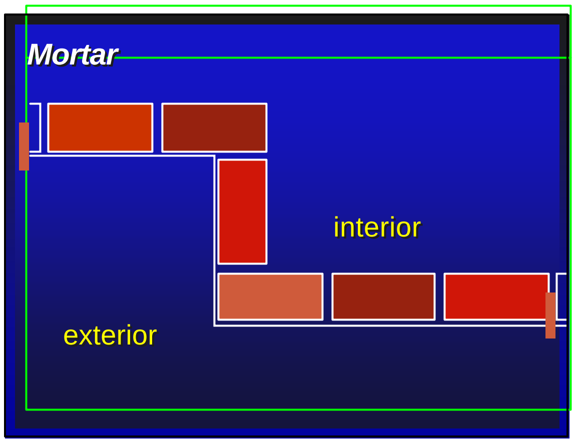

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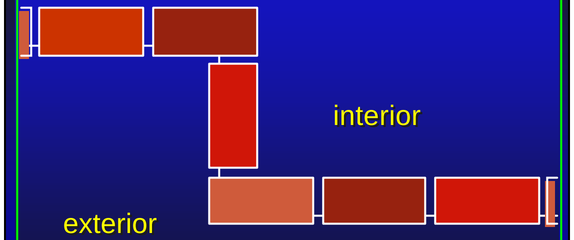

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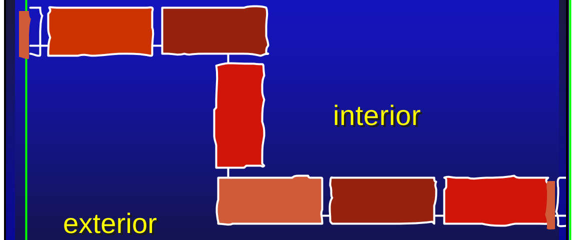
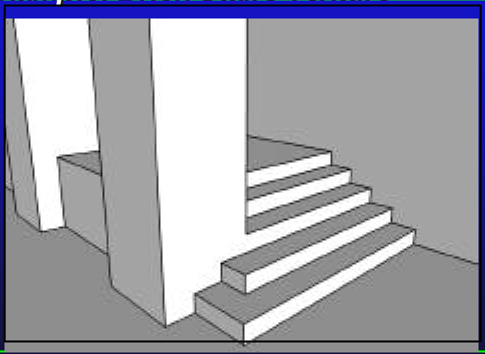
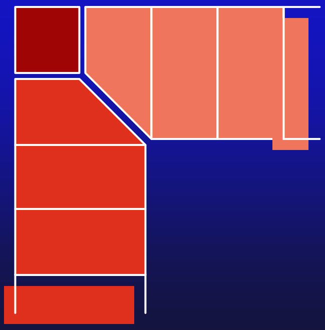


Example: Brick Stairs Texture



Pattern Segmentation



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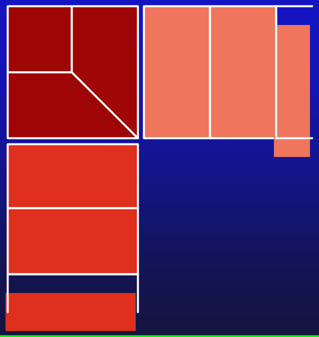

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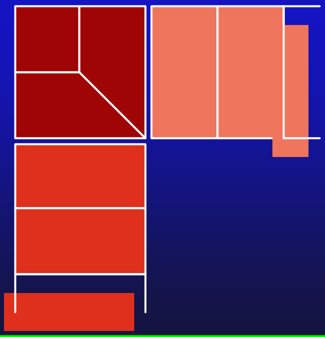
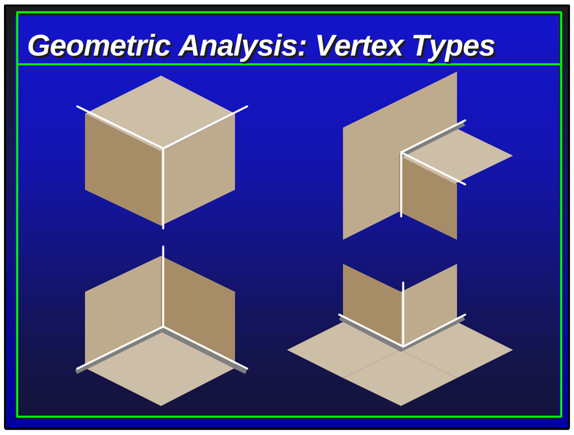
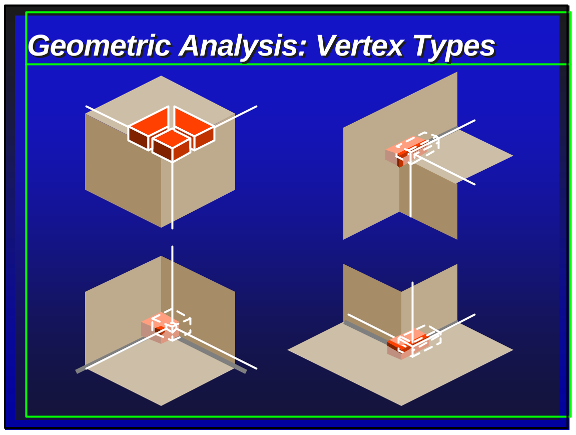




Geometric Analysis: Vertex Types



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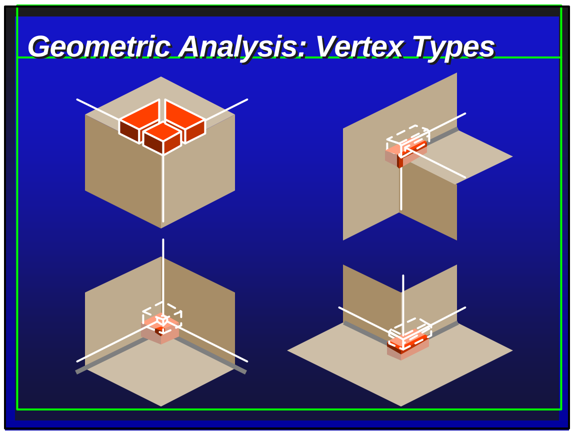

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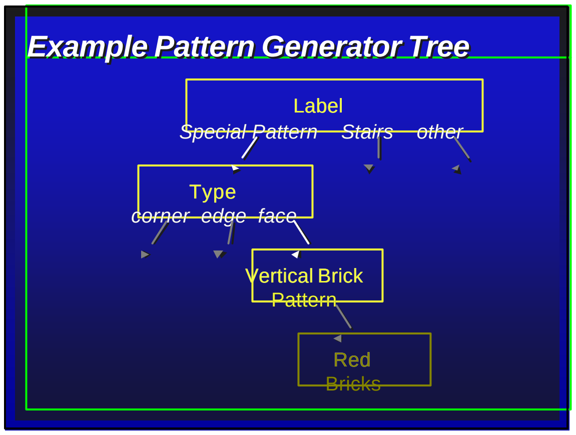

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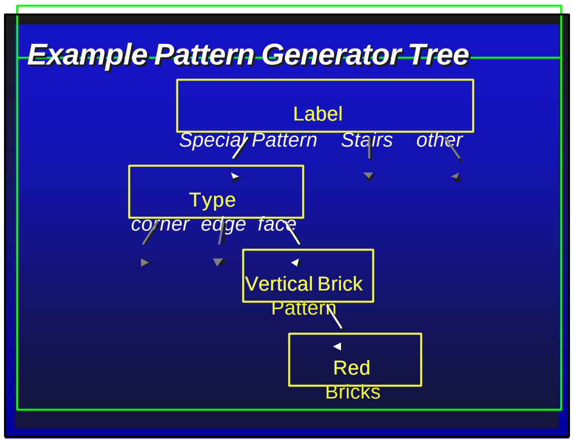

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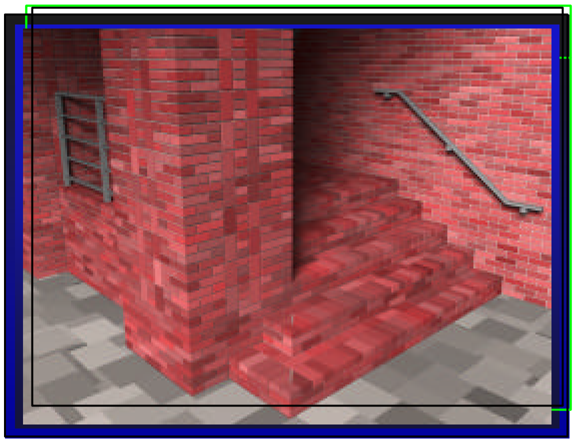
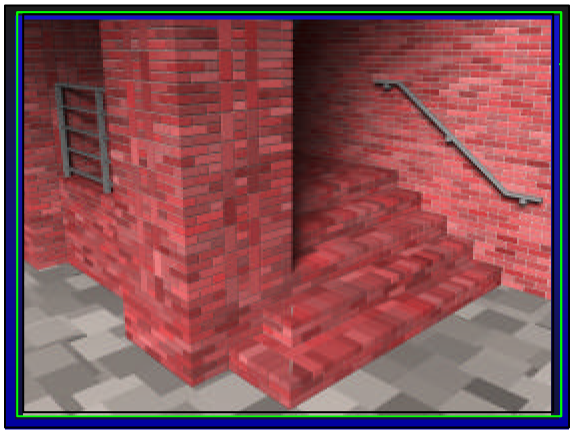
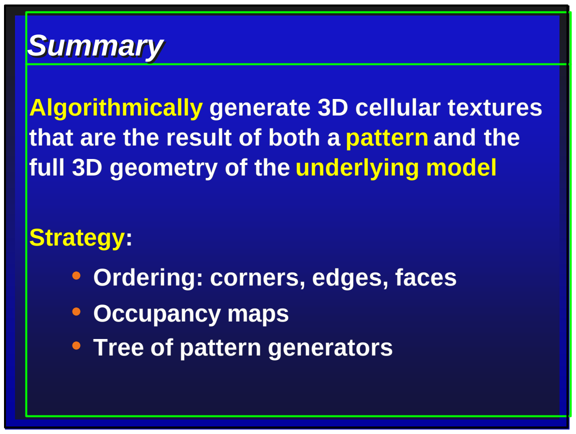




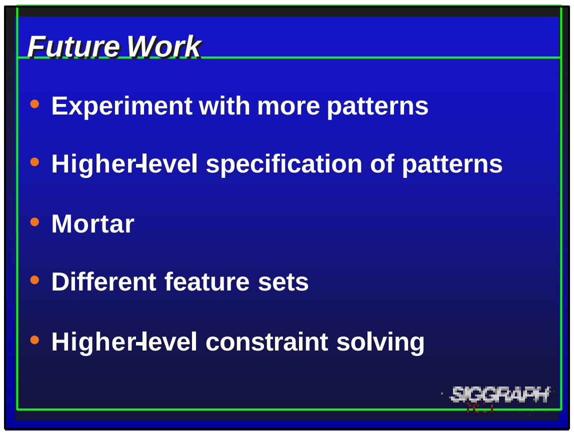


Summary

Algorithmically generate 3D cellular textures that are the result of both a pattern and the full 3D geometry of the underlying model

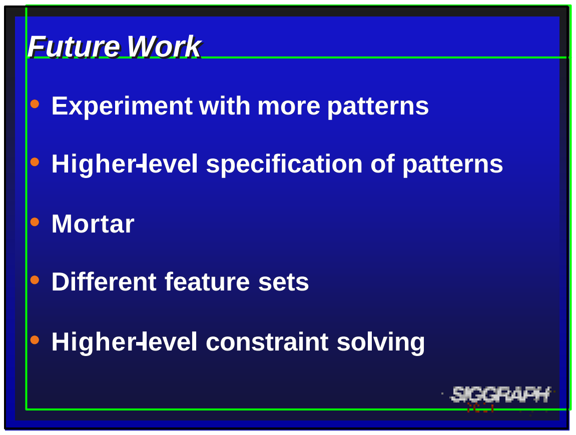
Strategy:

- **Ordering: corners, edges, faces**
- **Occupancy maps**
- **Tree of pattern generators**



Future Work

- **Experiment with more patterns**
- **Higher-level specification of patterns**
- **Mortar**
- **Different feature sets**
- **Higher-level constraint solving**



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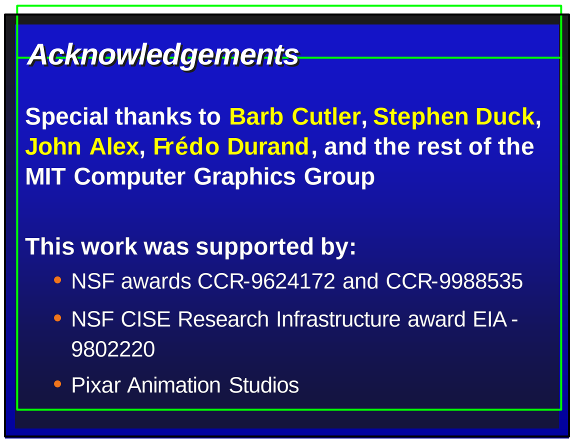

Acknowledgements

Special thanks to Barb Cutler, Stephen Duck, John Alex, Frédo Durand, and the rest of the MIT Computer Graphics Group

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- NSF awards CCR-9624172 and CCR-9988535
- NSF CISE Research Infrastructure award EIA-9802220
- Pixar Animation Studios